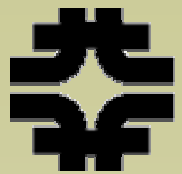
Piping Flexibility Studies Using IDEAS Finite Element Analysis Software



Fermilab

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Presentation Outline

- What is piping flexibility?
- Project objectives
- Analysis description
- Results
- Recommendations

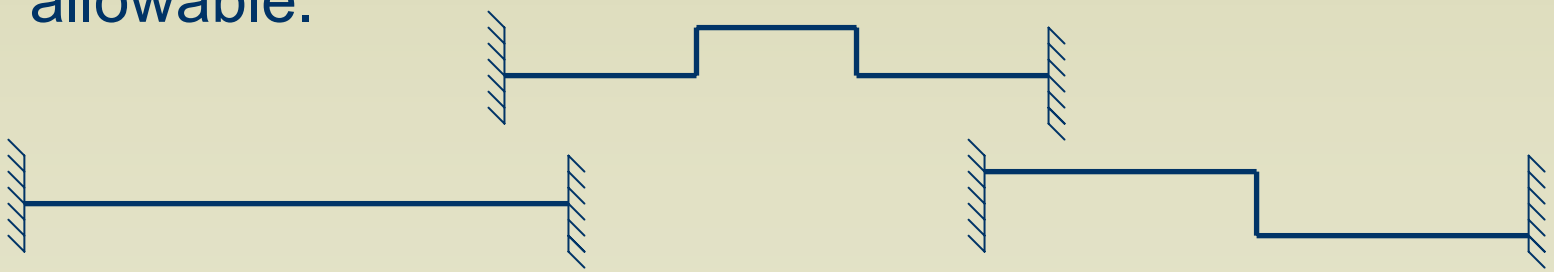
What is piping flexibility?

- Why?

  Engineering materials respond to temperature rise with a nearly proportional increase of linear dimensions

For stainless steel→ 9.6 micro-inches per inch per deg. F.

- Piping needs to be flexible to account for thermal expansion and to keep thermal stresses below the allowable.



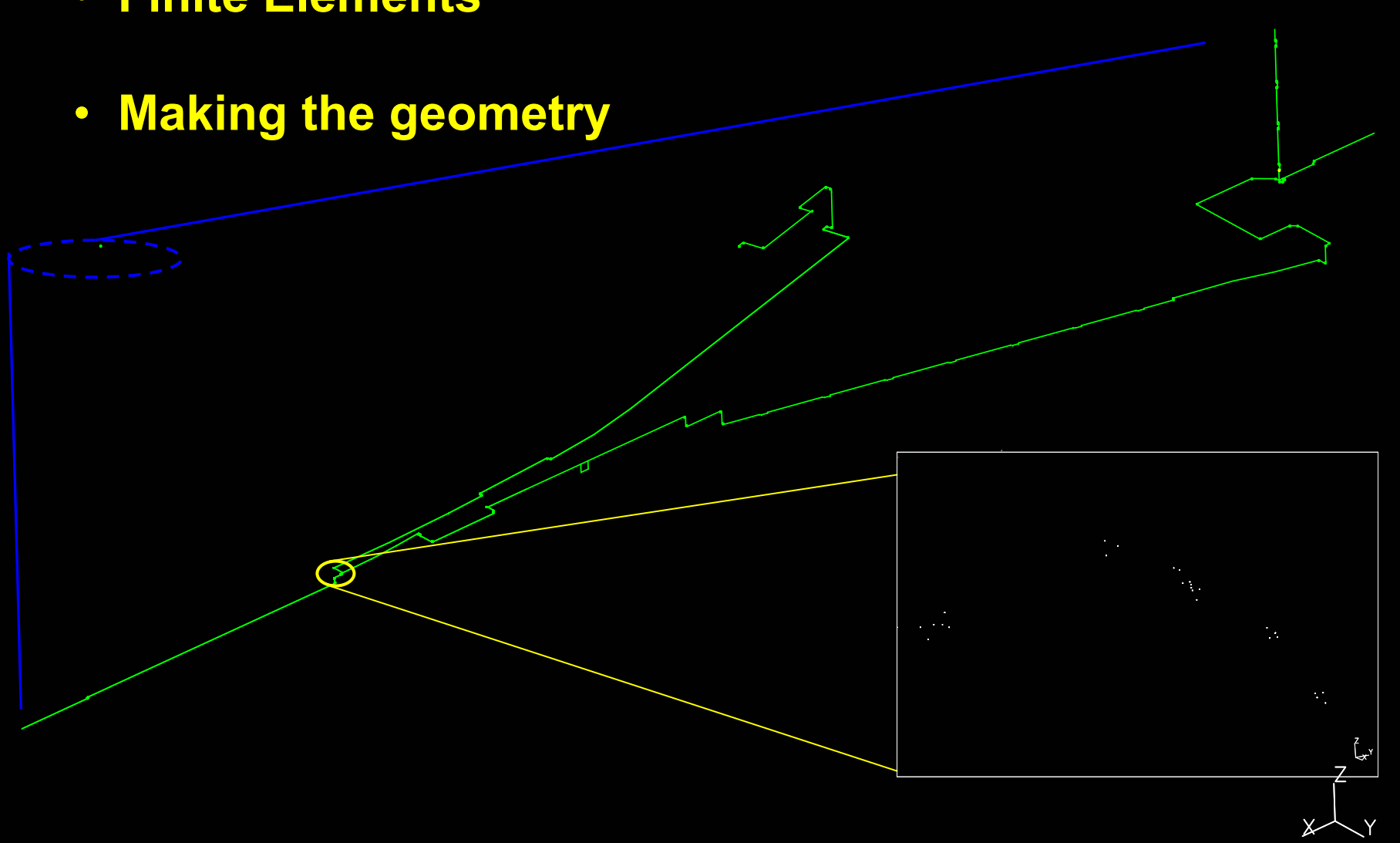
Project Objectives

- **Serve as an engineering note** to make suggestions and changes to assure that the piping system will work correctly under the influence of temperature changes.

- **Thoroughly describe the analysis method developed** to be helpful in future analysis of this sort and other kinds of structural analysis.

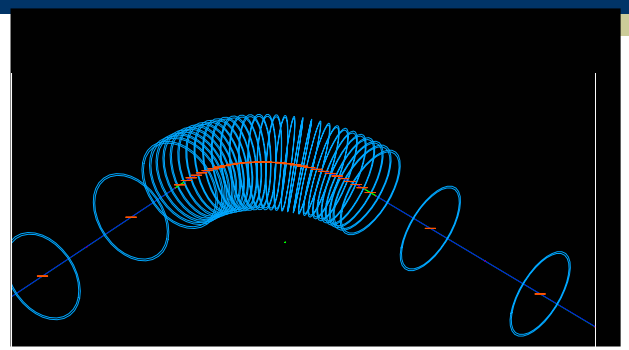
Analysis Description

- **Finite Elements**
- **Making the geometry**



Analysis Description

- Meshing



- Boundary conditions
  - Clamp
  - Gap elements
  - Temperature

- Approach to model solution
  - Start simple, add more gap elements as needed.

Results

- Maximum stress

  20100 psi

- Maximum reaction vector

  {-3225, -47, -509, -434, 0, -2748}

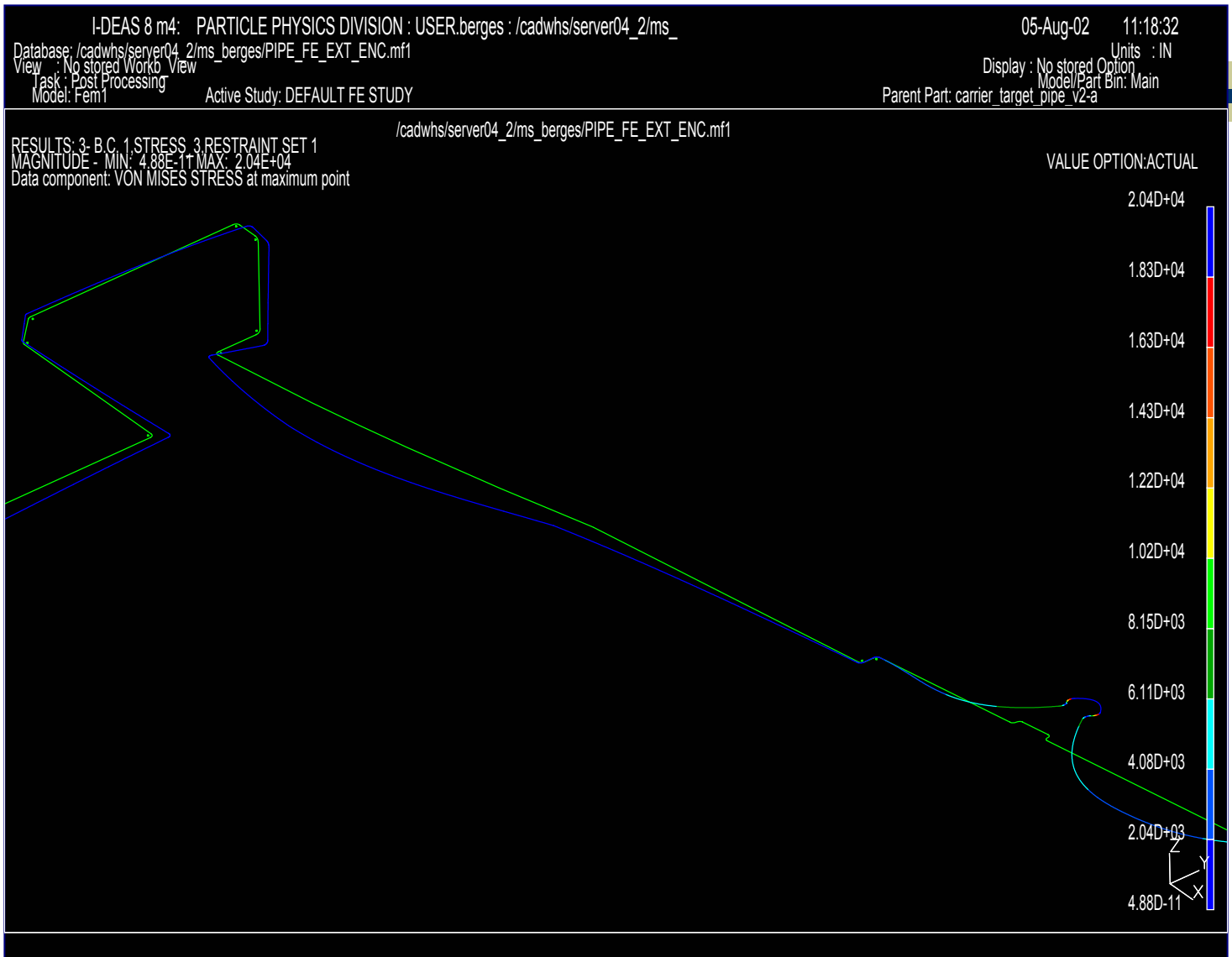
- Maximum contact force

  70#

- Maximum longitudinal displacement

  3.70”

Results


I-DEAS 8 m4: PARTICLE PHYSICS DIVISION : USER.berges : /cadwhs/server04_2/ms_
05-Aug-02 11:18:32
Database: /cadwhs/server04_2/ms_berges/PIPE_FE_EXT_ENC.mf1
Units : IN
View : No stored Workb View
Display : No stored Option
Task : Post Processing
Model/Part Bin: Main
Model: Fem1
Active Study: DEFAULT FE STUDY
Parent Part: carrier_target_pipe_v2-a
/cadwhs/server04_2/ms_berges/PIPE_FE_EXT_ENC.mf1
RESULTS: 3- B.C. 1,STRESS, 3,RESTRAINT SET 1
MAGNITUDE - MIN: 4.88E-11 MAX: 2.04E+04
Data component: VON MISES STRESS at maximum point
VALUE OPTION:ACTUAL
2.04D+04
1.83D+04
1.63D+04
1.43D+04
1.22D+04
1.02D+04
8.15D+03
6.11D+03
4.08D+03
2.04D+03
4.88D-11
Z
Y
X

Recommendations

- Reaction at ends
- Support clearance
- Location and spacing of supports
- Design of the middle part of the system to remove carrier clamps.

Open Forum

Thank you!